

SPECTRUM OF CP STARS: STARK WIDTH OF HEAVY ION LINES

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We present here the results of our investigation of Stark broadening for a number of astrophysically important heavy ion lines in order to provide the corresponding Stark broadening data needed for astrophysical purposes.

A number of heavy ion (Zn II, Sb II, Bi II, Pb II etc.) spectral lines has been observed in spectra of CP (O, B and A type) stars atmospheres (see e.g. Jacobs & Dworetzky 1982, Sadakane *et al.* 1988, Fuhrmann 1989, Danezis *et al.* 1991, etc.), where Stark broadening is the main pressure broadening mechanism. As an example two Zn II spectral lines for four Hg – Mn stars are shown in Fig. 1. Stark broadening data for heavy ion lines are of interest for analysis of hot CP star spectra as e.g. for abundance determination, for nucleosynthesis research, for investigation of pure diffusion in CP stars etc.

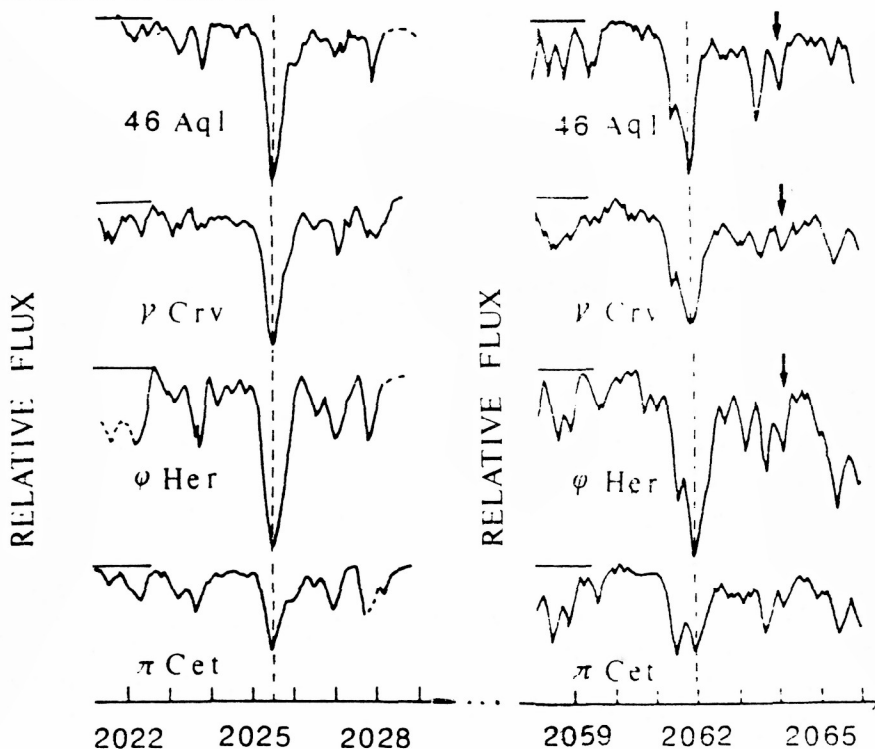


Fig. 1. IUE spectra around the Zn II 2025.5 Å and 2061.9 Å resonance lines in spectra of four Hg–Mn stars. The Zn II at 2064.2 Å subordinate line is indicated by an arrow (see Sadakane *et al.* 1988).

Stark broadening is dominant pressure broadening mechanism for CP stars with $T_{eff} \gtrsim 10000$ K (see Fig.2). However Stark broadening of lines originating from energy levels with principal quantum numbers may be important even for cooler stars (Vince *et al.* 1985).

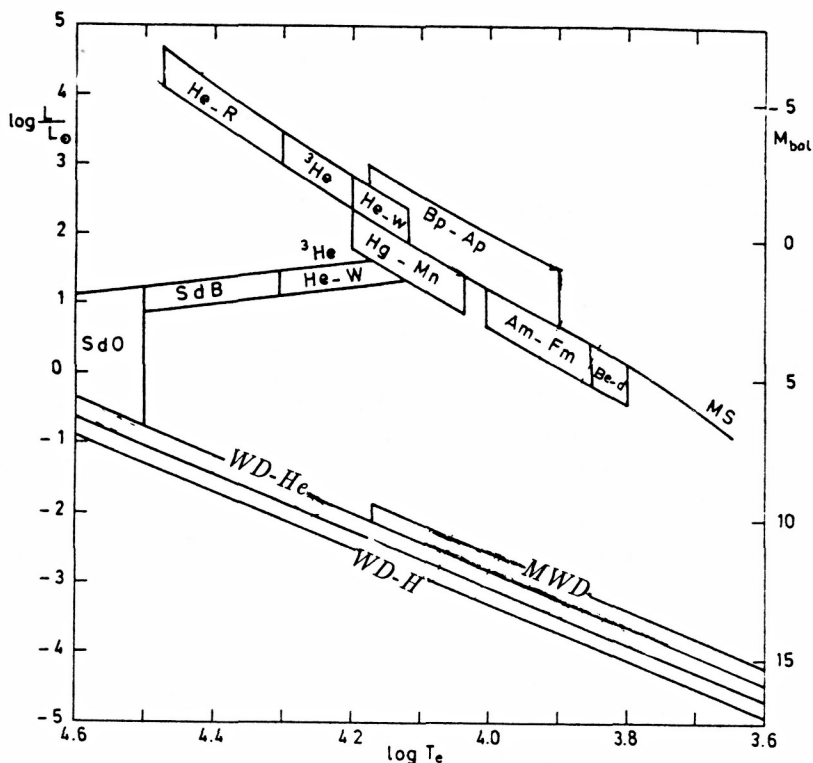


Fig. 2. The Hertzsprung-Russel diagram for CP stars. The used notations: MS - main sequence; Fm and Am - stars with strong metal lines (class F and A, respectively); Be-d - the beryllium deficient stars; Bp and Ap - the peculiar stars of class B and A, respectively; Hg-Mn - stars with anomal Hg and Mn abundance; He-W - helium weak stars; ^3He -W - helium weak stars with anomalous $^3\text{He}/^4\text{He}$ isotopic ratio; He-R - helium reach stars; SdO - helium weak subdwarfs; SdB - helium reach subdwarfs; WD-H - hydrogen reach white dwarfs, WD-He - helium rich white dwarfs; MWD - white dwarfs whose spectra show metallic absorption lines (see Vauclair & Vauclair 1982).

Besides the astrophysical importance, Stark broadening parameters of heavy ion lines are interesting for laboratory plasma diagnostic as well. Consequently these lines have been investigated experimentally (see e.g. Miller & Bengston 1980, Purić *et al.* 1985, Djeniže *et al.* 1991, Labat *et al.* 1991, Djeniže *et al.* 1992, Djeniže *et al.* 1993, etc.) and theoretically too (see e.g. Dimitrijević & Sahal-Bréchet 1992, Dimitrijević & Popović 1993, Popović *et al.* 1993, etc.).

We have investigated Stark width (HWHM) for several astrophysically important lines for seven of singly charged heavy ions (Zn II, Br II, Sb II, As II, Cd II, I II and Bi II). Stark broadening data are calculated within the modified semiempirical approach

(Dimitrijević & Konjević 1980) for electron density of $N_e = 10^{17} \text{ cm}^{-3}$ and electron temperature range from 5000 to 50 000 K.

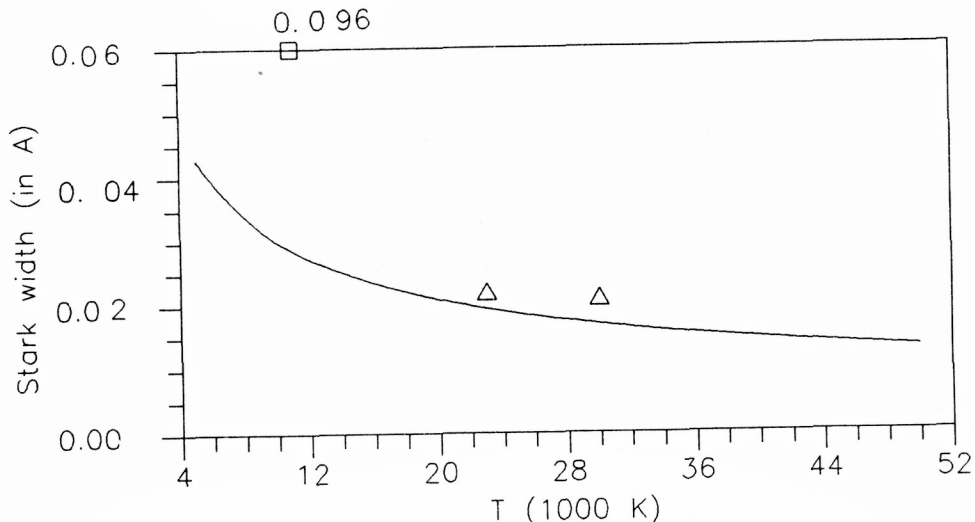


Fig 3. Stark width (HWHM) for Cd II 2265.0 Å ($5s^2S_{1/2} - 5p^2P_{1/2}^0$) spectral line as a function of temperature (T), at electron density of $N_e = 10^{17} \text{ cm}^{-3}$. The used notation: (—) - our results, (Δ) - experimental data of Djenize et al. (1991) and (\square) - experimental data of Kusch & Oberschelp (1967).

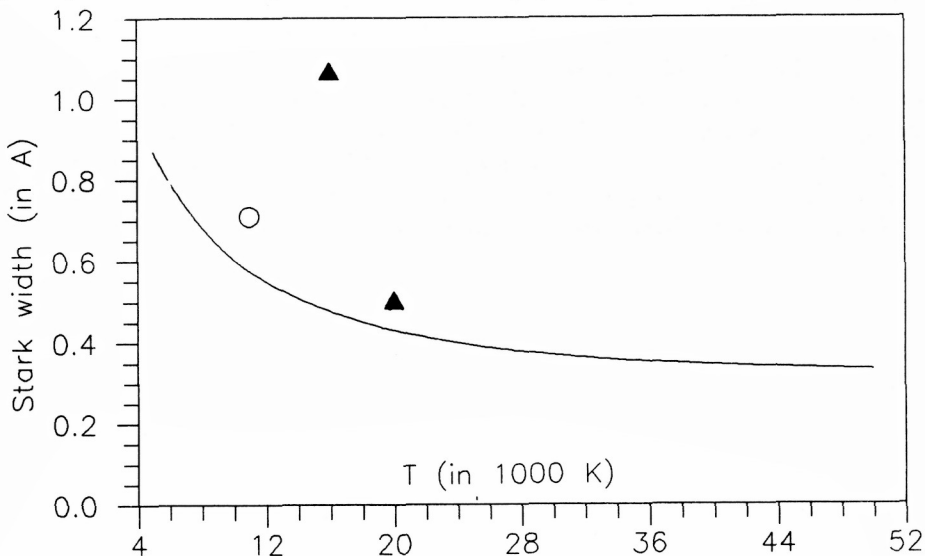


Fig 4. Stark width (HWHM) for Bi II 5719 Å spectral line ($7s^3P_1^0 - 7p^3P_0$). The used notation: (—) - our results, \blacktriangle - experimental data by Purić et al. (1985), \circ - experimental data by Miller & Bengston (1980).

Our theoretical results have been compared with available experimental data (Kusch & Oberschelp 1967, Miller & Bengston 1980, Purić *et al.* 1985, Labat *et al.* 1991, Djeniže *et al.* 1991, etc.). Taking into account the complexity of heavy ion spectrum, the accordance of calculated with experimental data (as e.g. for Cd II and Bi II shown in Figs. 3 and 4.) is very encouraging.

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